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Natural history museums as repositories of endangered diversity: the case of the United States Unionida in the Museo di Zoologia dell'Università di Bologna

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Abstract

The importance of natural history museums is often underappreciated, but they provide society with a number of services. Among these, they are a fundamental tool for assessing extinction rates and range contractions, or the only way to access species extinct in historical times. In this perspective, we describe here the collection of Unionida of the Museo di Zoologia dell'Università di Bologna, containing one extinct (*Epioblasma haysiana*) and nine threatened species, plus another 47 species. The collection was built in the mid-19th century and potentially provides baseline information for specialists. In the fragmented natural history museum system of Italy, this might be just the tip of the iceberg of a significant and important amount of material collected in the 19th and early-20th century.

Key Words

Unionidae
Margaritiferidae
extinct species
museums
natural history collections

Introduction

Natural history museums provide society with a number of indispensable, although often underappreciated, services in the fields of homeland security, public health and safety, agriculture, monitoring of environmental change, traditional taxonomy and systematics (Suarez and Tsutsui 2004). They are also indispensable for the study of the state and trends of biodiversity, providing baseline information useful to assess change at the genetic, species, community and landscape level. They are sometimes the only repositories of specimens of taxa which have gone extinct in historical times, and allow studies on endangered taxa avoiding new captures.

The 'Museo di Zoologia dell'Università di Bologna' is no exception. In its present form, it dates back to the 1930s, but it actually contains specimens dating back to the 16th century (collected by Ulisse Aldrovandi, 1522-1605). It was then enriched by the collections of F. Cospi (1609-1686) and L.F. Marsigli (1658-1730), and further developed during the 19th century, mainly due to the work of its directors C. Ranzani (1775-1841) and G.G. Bianconi (1809-1878), and 20th century, due to the commitment of A. Ghigi (1875-1970). The value of the museum as repository of specimens of extinct or endangered species has been already recognized for vertebrates; for example it contains a head of a great auk, *Pinguinus impennis* (Linnaeus, 1758), which became extinct in the mid-19th century. However, no recognition was ever given to the value of its invertebrate collections, of which here we present the North-American Unionida.

The Unionida is a diverse order of bivalves with ca. 840 species worldwide. The Neartic (especially the SE United States) has the highest concentration of Unionida diversity in the world, comprising ca. 300 species alone (Graf and Cummings 2007, Bogan 2008). However, this richness has been threatened by the construction of dams, pollution and sediment toxicity, wetland drainage and channelization, sedimentation and siltation resulting from poor agricultural and silvicultural practices, highway and bridge

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construction, interbasin transfer schemes, habitat loss through dredging, and other land-use activities (Lydeard et al. 2004). At present, 235 species have been assessed, of which 27 (11%) are considered extinct, 50 (21%) critically endangered, 31 (13%) endangered and 11 (5%) vulnerable (IUCN Red List, last accessed July 2013).

Our work recovered the collection of Unionida in the Museo di Zoologia dell'Università di Bologna, Italy, a collection dating back to the 19th century. This collection is likely to be only the tip of the iceberg among many other collections, hidden in the Italian fragmented natural history museum system. Our aims are therefore to highlight the value of historic natural history collections as repositories of specimens of extinct or endangered species. In a time of increased awareness of global biological changes, museums are valuable reservoirs of baseline information. Moreover, we wish to bring to the attention of the international scientific community the hidden treasures in the Italian museums, and foster research on their material.

Methods

We recovered the collection of North American Unionida, cleaned all specimens, labels and original boxes, and transferred them into zip-lock plastic bags along with all original labels. Also the original boxes, likely to belong to early 20th century were preserved. The most interesting lots were photographed. Identification was checked, nomenclature updated following the MUSSELp database (Graf and Cummings 2013), which proved particularly useful in tackling old names, and the conservation status of each species was recorded on the basis of published assessments (IUCN Red List, U.S. Fish and Wildlife Service). Samples were databased, and research into the biography of the main contributors to the collection performed. The collection also contains several lots from Europe, as well as samples from South America, Africa and Asia, which were cleaned, but not analysed in detail.

Results

Eighty-six specimens of North-American Unionida are preserved in the Museum (Table 1 gives a list) in 76 lots, representing two families (Unionidae and Margaritiferidae) and 57 species. The condition of specimens is generally very good, with most valves being paired, and only a few having cracks or other defects. The collection comprises further 34 lots (104 specimens and 22 valves) from Europe, 21 lots (31 specimens and two valves) from the Central and South America, three lots (three specimens) from sub-Saharan Africa, and two lots (two specimens) from New Zealand, which will not be further commented upon here.

Of these 57 species, 10 (17.5%) are currently considered extinct or threatened by IUCN. In particular, one is considered extinct (*Epioblasma haysiana* (Lea, 1834), Figure 1 E-F), five critically endangered, two endangered and two vulnerable. The U.S. Fish and Wildlife Service lists as "endangered" further three species not assessed by IUCN: *Epioblasma obliquata* (Rafinesque, 1820), *E. torulosa rangiana* (Lea, 1838) and *E. triquetra* (Rafinesque, 1820).

Most of the lots were received from M.E. Moricand (1779-1854) (Fig. 2 A-B), a Swiss collector, in the mid-1800s. His collection was particularly rich, especially of land shells: his son M.J. Moricand catalogued his collection in 1859 censing 5,950 species and about 25,000 specimens (Cailliez, 1983). A few more lots from the Mississippi River are dated 1863 and belonged to the Capellini collection (Fig. 2 C). Giovanni Capellini (1833-1922) was a professor of geology at the University of Bologna, and travelled in 1863 to the United States (Vai, 2002).

Discussion

Museum collections are increasingly becoming the only source of information on extinction rates and range contractions, or the only way to access species extinct in historial times (Allmon 1994). The case study here reported shows that the effort to recover an historical 19th century collection allowed the recognition of an extinct species and of several endangered species, belonging to one of the most imperiled groups of molluscs worldwide. The specimens themselves, and the data accompagnying them, provide researchers with a historic record of where extinct and endangered species once lived. Notwithstanding natural history collections are then a vital resource for conservation research, the recognition of their importance is often lacking.

Even when the value of natural history collections as sources of long-term or past datasets is recognized (Lister et al. 2011), locating material of interest is often difficult due to the fragmentation of the museum system in some countries, the lack of computerization of collection data, or the lack of availability to the public (e.g. via internet) (O'Connell et al. 2004). The Museo di Zoologia dell'Università di Bologna does not have permanent personnel, and all curatorial work is carried out by university researchers and students in the framework of their research assignments or on voluntary basis. The malacological collection is partly databased, but the database is not readily available to the public. Publishing the results of this work will hopefully contribute to arise consciousness on the value of natural history collections, and start spreading information to the scientific community on the Italian invertebrate historical collections. Indeed, the Italian museum system had its golden years in the second half of the 19th century and early 20th century (see for a narrative on vertebrate collections Gippoliti (2005)). Therefore, further collections of interest can be expected when digging into the old cabinets of the Italian museums.

Table 1. List of North-American Unionida preserved at the Museo di Zoologia dell'Università di Bologna, Italy. Abbreviations: R.: River; IUCN: International Union for the Conservation of Nature; USFWS: United States Fish and Wildlife Service; IUCN categories: DD Data Deficient, LC Least Concern, NT Near Threatened, VU Vulnerable, EN Endangered, CR Critically Endangered, EX Extinct.

Species	Locality	Number of specimens	Source	Conservation status
Actinonaias ligamentina (Lamarck, 1819)	Ohio R.	2 lots, three specimens	M.J. Moricand	LC (IUCN)
Actinonaias cfr. *ligamentina* (Lamarck, 1819)	No locality	2 lots, 2 specimens	Not known	Not evaluated
Alasmidonta heterodon (Lea, 1829)	Connecticut R.	1 lot, 1 specimen and 1 valve	M.J. Moricand	VU (IUCN)
Alasmidonta marginata Say, 1818	Wabash R.	1 lot, 1 specimen	M.J. Moricand	DD (IUCN)
Alasmidonta undulata (Say, 1817)	Delaware R.	1 lot, 2 specimens	M.J. Moricand	LC (IUCN)
Alasmidonta varicosa (Lamarck, 1819)	Delaware R.	1 lot, 1 specimen	M.J. Moricand	DD (IUCN)
Amblema plicata (Say, 1817)	Ohio R.	2 lots, 2 specimens	M.J. Moricand	LC (IUCN)
Amphinaias nodulata (Rafinesque, 1820)	Ohio R.	1 lot, 1 specimen	M.J. Moricand	LC (IUCN)
Amphinaias pustulosa (Lea, 1831)	Ohio R.; Mississippi R.	2 lots, 2 specimens	M.J. Moricand; G. Capellini (1863)	LC (IUCN)
Cyprogenia stegaria (Rafinesque, 1820) (Fig. 1 A, B)	Ohio R.	2 lots, 2 specimens	M.J. Moricand (1844)	CR (IUCN)
Dromus dromas (Lea, 1834) (Fig. 1 C-D)	Cumberland R.	1 lot, 1 specimen	M.J. Moricand	CR (IUCN), Endangered (USFWS)
Ellipsaria lineolata (Rafinesque, 1820)	Ohio R.; Mississippi R.	2 lots, 2 specimens	M.J. Moricand; G. Capellini (1863)	NT (IUCN)
Elliptio complanata (Lightfoot, 1786)	Delaware R.	1 lot, 1 specimen	M.J. Moricand	LC (IUCN)
Elliptio congaraea (Lea, 1831)	Altamaha R.	1 lot, 1 specimen	M.J. Moricand	NT (IUCN)
Elliptio crassidens (Lamarck, 1819)	Ohio R.	1 lot, 1 specimen	M.J. Moricand	LC (IUCN)
Elliptio cylindracea Frierson, 1927	Altamaha R.	1 lot, 1 specimen	M.J. Moricand	DD (IUCN)
Elliptio dilatata (Rafinesque, 1820)	Ohio R.; Illinois	2 lots, 2 specimens	M.J. Moricand	LC (IUCN)
Elliptio fisheriana (Lea, 1838)	Maryland	1 lot, 1 specimen	M.J. Moricand	LC (IUCN)
Elliptio hopetonensis (Lea, 1838)	Altamaha R.	2 lots, 2 specimens	M.J. Moricand	LC (IUCN)
Elliptio lanceolata (Lea, 1828)	Tennessee	1 lot, 1 specimen	M.J. Moricand	NT (IUCN)
Elliptio shepardiana (Lea, 1834)	Ohio R.	1 lot, 1 specimen	M.J. Moricand	NT (IUCN)
Epioblasma haysiana (Lea, 1834) (Fig. 1 E-F)	Cumberland R.	1 lot, 1 specimen	M.J. Moricand	EX (IUCN)
Epioblasma obliquata (Rafinesque, 1820)	Ohio R.	1 lot, 1 specimen	M.J. Moricand	Not evaluated (IUCN), Endangered (USFWS)
Epioblasma torulosa (Rafinesque, 1820) (Fig. 1 G-H)	Ohio R.	1 lot, 1 specimen	M.J. Moricand	CR (IUCN), Endangered (USFWS)
Epioblasma torulosa rangiana (I. Lea, 1838).	Ohio R.	1 lot, 2 specimens	M.J. Moricand	Not evaluated (IUCN), Endangered (USFWS)
Epioblasma triquetra (Rafinesque, 1820)	Ohio R.	1 lot, 1 specimen	M.J. Moricand	Not evaluated (IUCN), Endangered (USFWS)
Fusconaia flava (Rafinesque, 1820)	Ohio R.; Mississippi R.	2 lots, 4 specimens	M.J. Moricand; G. Capellini (1863)	LC (IUCN)
Lampsilis cariosa (Say, 1817) (Fig. 1 I-J)	Delaware R.	2 lots, 2 specimens	M.J. Moricand (1844)	EN (IUCN)
Lampsilis hydiana (Lea, 1838)	Lousiana	1 lot, 1 specimen	M.J. Moricand	LC (IUCN)

Species	Locality	Number of specimens	Source	Conservation status
Lampsilis siliquoidea (Barnes, 1823)	Ohio	2 lots, 3 specimens	M.J. Moricand	LC (IUCN)
Lampsilis sp.	–	1 lot, 1 specimen	–	
Lampsilis teres (Rafinesque, 1820)	Mississippi R., Louisiana	2 lots, 2 specimens	G. Capellini (1863); M.J. Moricand	LC (IUCN)
Lasmigona compressa (Lea, 1829)	Ohio R.	1 lot, 1 specimen	M.J. Moricand	LC (IUCN)
Lasmigona costata (Rafinesque, 1820)	Ohio	1 lot, 1 specimen	M.J. Moricand	NT (IUCN)
Leptodea ochracea (Say, 1817)	Delaware R.; North America	2 lots, 3 specimens	M.J. Moricand; Champlain	NT (IUCN)
Ligumia nasuta (Say, 1817)	Mississippi R.	1 lot, 1 specimen	G. Capellini (1863)	NT (IUCN)
Ligumia recta (Lamarck, 1819)	Ohio R.	1 lot, 1 specimen	M.J. Moricand	LC (IUCN)
Medionidus conradicus (Lea, 1834)	Holston R. in Tennessee	1 lot, 1 specimen	M.J. Moricand	NT (IUCN)
Obliquaria reflexa Rafinesque, 1820	Ohio R.; Mississippi	2 lots, 4 specimens	M.J. Moricand; G. Capellini (1863)	Not evaluated
Obovaria olivaria (Rafinesque, 1820)	Mississippi R.	1 lot, 1 specimen	G. Capellini (1863)	LC (IUCN)
Obovaria subrotunda Rafinesque, 1820)	Ohio R.	1 lot, 1 specimen	M.J. Moricand	NT (IUCN)
Pleurobema clava (Lamarck, 1819) (Fig. 3 A-B)	Ohio R.	1 lot, 1 specimen	M.J. Moricand	CR (IUCN), Endangered (USFWS)
Pleurobema oviforme (Conrad, 1834)	Haleton R.	2 lots, 3 specimens	M.J. Moricand	VU (IUCN)
Pleurobema rubrum (Rafinesque, 1820)	North America	1 lot, 1 specimen	M.J. Moricand	NT (IUCN)
Pleurobema sintoxia (Rafinesque, 1820)	Ohio R.	1 lot, 1 specimen	M.J. Moricand	LC (IUCN)
Potamilus alatus (Say, 1817)	2 lots without label; third: Mississippi R.	3 lots, 3 specimens	2 lots without label; third: G. Capellini (1863)	LC (IUCN)
Pyganodon gibbosa (Say, 1824)	Altamaha R.	1 lot, 1 specimen	M.J. Moricand	NT (IUCN)
Quadrula cylindrica (Say, 1817)	Cumberland R.	1 lot, 1 specimen	M.J. Moricand	NT (IUCN), Threatened (USFWS)
Quadrula quadrula (Rafinesque, 1820)	Mississippi R.	1 lot, 1 specimen	G. Capellini (1863)	LC (IUCN)
Quadrula metanevra (Rafinesque, 1820) (Fig. 3 C-D)	Ohio	1 lot, 1 specimen	M.J. Moricand	CR (IUCN)
Quadrula verrucosa (Rafinesque, 1820)	–	1 lot, 1 specimen	–	Not evaluated
Toxolasma lividum (Rafinesque, 1831)	Ohio R.	1 lot, 1 specimen	M.J. Moricand	Not evaluated
Toxolasma parvum (Barnes, 1823)	Ohio R.	1 lot, 1 specimen	M.J. Moricand	LC (IUCN)
Truncilla donaciformis (Lea, 1828)	North America; Ohio	2 lots, 1 specimen and 1 valve	M.J. Moricand	LC (IUCN)
Utterbackia imbecillis (Say, 1829)	Ohio R.	1 lot, 3 specimens	M.J. Moricand	LC (IUCN)
Unidentified	–	2 lots, 1 complete specimen and 1 valve	–	–
Margaritifera margaritifera Linnaeus, 1758 (Fig. 3 E-F)	Small streams in Pennsylvania	1 lot, 1 specimen	M.J. Moricand	EN (IUCN)

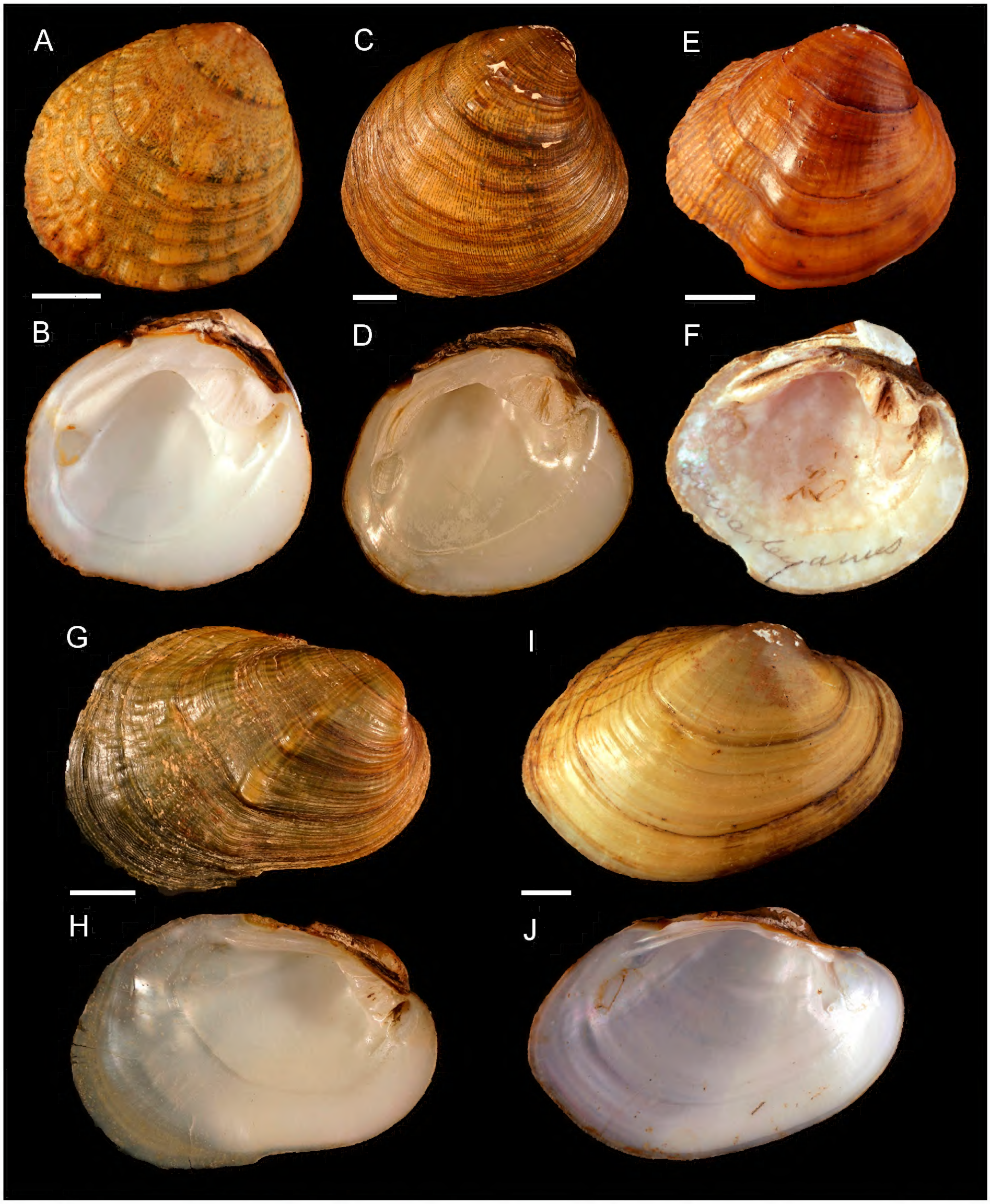

Figure 1. North-American Unionida of conservation concern in the Museo di Zoologia dell'Università di Bologna, Italy. **A-B.** *Cyprogenia stegaria* (Rafinesque, 1820), Critically Endangered (IUCN), Cumberland River, length 40 mm; **C-D.** *Dromus dromas* (Lea, 1834), Critically Endangered (IUCN), Endangered (USFWS), Cumberland River, length 64 mm; **E-F.** *Epioblasma haysiana* (Lea, 1834), Extinct (IUCN), Cumberland River, length 41 mm; **G-H.** *Epioblasma torulosa* (Rafinesque, 1820), Critically endangered (IUCN), Endangered (USFWS), Ohio River, length 56 mm; **I-J.** *Lampsilis cariosa* (Say, 1817), Endangered (IUCN), Delaware River, length 76 mm. Scale bar 1 cm.

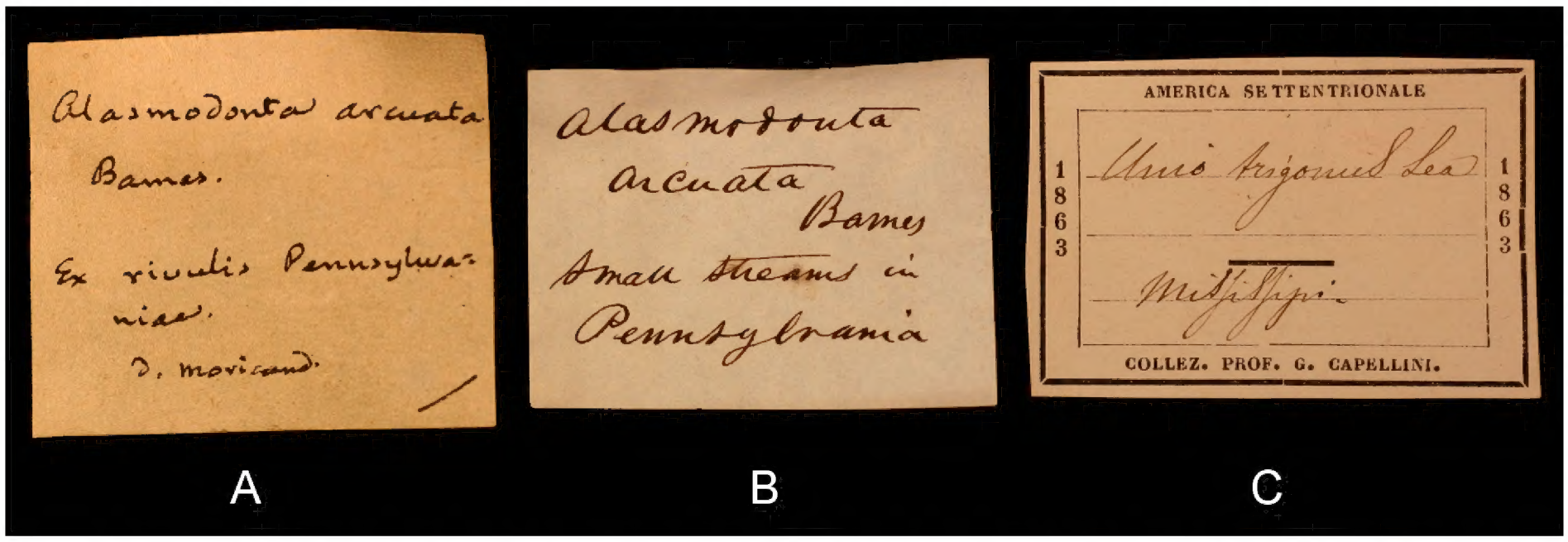

Figure 2. Examples of original labels of North-American Unionida in the Museo di Zoologia dell'Università di Bologna, Italy. A. M.E. Moricand's label, in latin. B. Labels accompanying M.E. Moricand's specimens in English. C. G. Capellini's label.

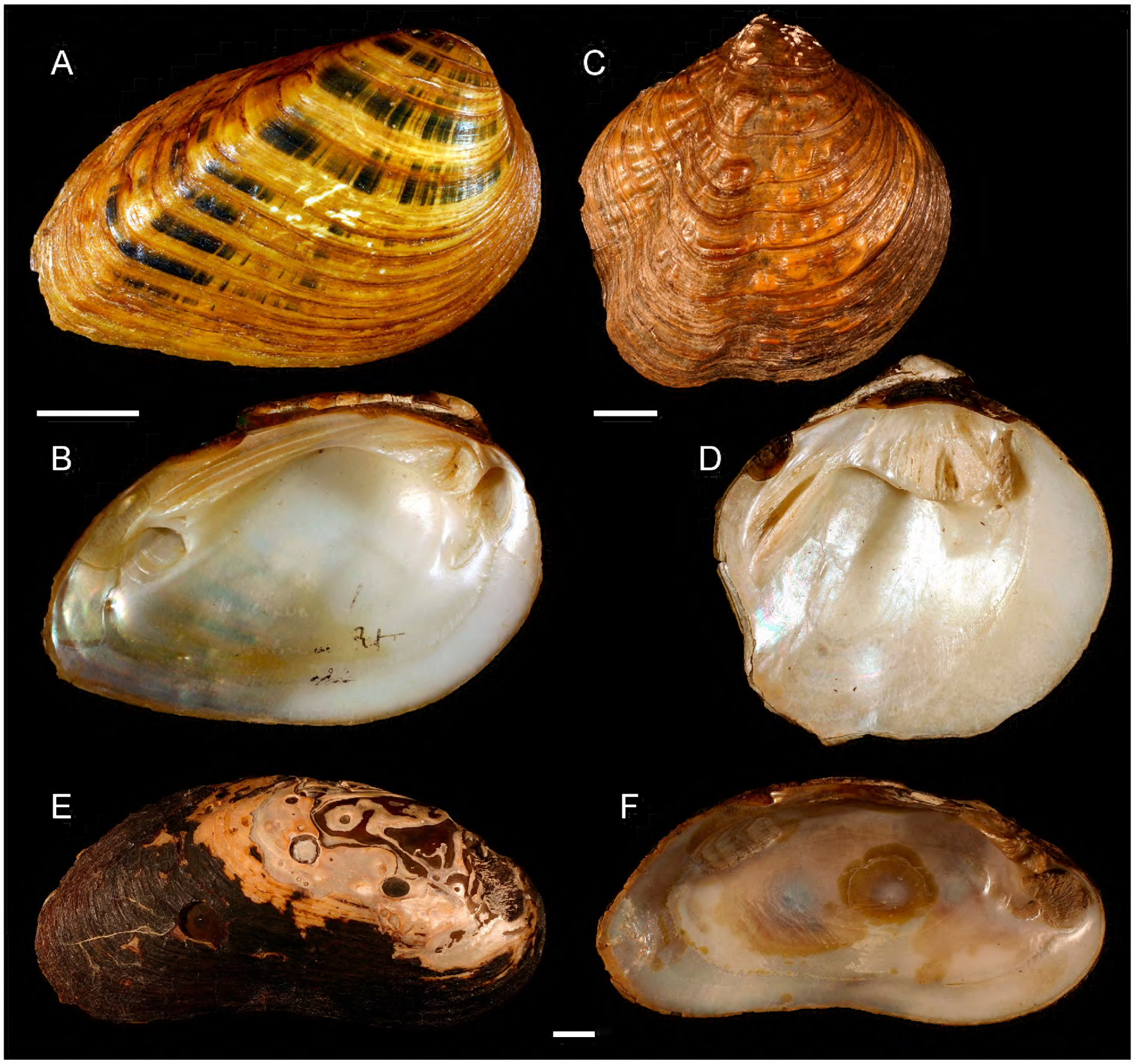

Figure 3. North-American Unionida of conservation concern in the Museo di Zoologia dell'Università di Bologna, Italy. **A-B.** *Pleurobema clava* (Lamarck, 1819), Critically Endangered (IUCN), Endangered (USFWS), Ohio River, length 50 mm; **C-D.** *Quadrula metanevra* (Rafinesque, 1820), Critically Endangered (IUCN), Ohio River, length 59 mm; **E-F.** *Margaritifera margaritifera* Linnaeus, 1758, Endangered (IUCN), small streams in Pennsylvania, length 123 mm. Scale bar 1 cm.

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References

Allmon WD (1994) The value of natural history collections. Curator 37(2): 83–89.

Bogan AE (2008) Global diversity of freshwater mussels (Mollusca, Bivalvia) in freshwater. Global diversity of freshwater animals. Hydrobiologia 595:139–147. doi: 10.1007/s10750-007-9011-7

Cailliez JC (1995) Notice sur les collections malacologiques du Muséum d'Histoire Naturelle de Genève. Amis du Musém, Geneva, Switzerland, 49 pp.

Gippoliti S (2005) Historical museology meets tropical biodiversity conservation. Biodiversity and Conservation 14: 3127–3134. doi: 10.1007/s10531-004-0381-0

Graf DL, KS Cummings (2007) Review of the systematics and global diversity of freshwater mussel species (Bivalvia: Unionoida). Journal of Molluscan Studies 73: 291–314, doi: 10.1093/mollus/eym029

Graf DL, KS Cummings (2013) The Freshwater Mussels (Unionoida) of the World (and other less consequential bivalves), last update 8 August 2013. MUSSEL Project Web Site http://www.mussel-project.net/

Lister AM, Climate Change Research Group (2011) Natural history collections as sources of long-term datasets. Trends in Ecology and Evolution 26(4): 153–154. doi: 10.1016/j.tree.2010.12.009

Lydeard C, Cowie RH, Ponder WF, Bogan AE, Bouchet P, Clark SA, Cummings KS, Frest TJ, Gargominy O, Herbert DG, Hershler R, Perez KE, Roth B, Seddon M, Strong EE, Thompson FG (2004) The global decline of nonmarine mollusks. BioScience 54 (4): 321–330. doi: 10.1641/0006-3568(2004)054[0321:TGDONM]2.0.CO

O'Connell AF, Gilbert AT, Hatfield JS (2004) Contribution of Natural History Collection Data to Biodiversity Assessment in National Parks. Conservation Biology 18(5): 1254–1261. doi: 10.1111/j.1523-1739.2004.00034.x-i1

Suarez AV, Tsutsui ND (2004) The Value of Museum Collections for Research and Society. BioScience 54(1): 66–74. doi: 10.1641/0006-3568(2004)054[0066:TVOMCF]2.0.CO

Vai GB (2002) Giovanni Capellini and the origin of the International Geological Congress. Episodes 25(4): 248–254.